General Application Name: Finance/Tax Parcel Mapping

Product / Service / Function Name: Land Ownership Identification – Property Inventory

P/S/F Description:

Land ownership identification or property inventory refers to cataloging parcels and their location within a jurisdiction. The inventory process involves obtaining the legal land descriptions from deeds and creating a database to house the descriptive information about each parcel. Parcel maps may or may not be created as a result of the inventory process. Parcel inventories are used to help city planners and others with many tasks including predicting future land use and zoning problems, taxes, managing assessment and appraisal information, and keeping a record of property owners and sales. A GIS is ideal for maintaining this type of inventory because of its ability to map and query the data.

Product / Service / Function

1. Spatial Data -

Minimum Data Requirements

General Description	GIS Data Layer
Property Data	Parcels
Natural Features	Streams
	Lakes
	Flood zones
Transportation	Right-of-way and/or edge of pavement
	Road centerlines
Other	Deeds/Plat Surveys

Optional Data Requirements

General Description	GIS Data Layer
Planimetrics/Base Mapping	Orthophotography
	Building Footprints
Natural Features	Vegetation
Transportation	Railroads
	Driveways
	Parking Lots
Utilities Data	Water Lines
	Sewer Lines
	Gas
	Electric
	Storm water
Socio-Political Data	Census Block/Tract
	Municipal boundaries
	Zoning
	Land Use

	Neighborhoods & Subdivisions

2. Attribute Data –

Minimum Attribute Requirements

GIS Data Layer	Attributes
Parcels	Parcel/Tax ID
	Owner Name
	Owner Address
	Property Address
	Subdivision/Neighborhood
	Legal Description/Property Dimensions
	Acreage
	Property/Land Use (residential, commercial)
	Assessment Date
	Assessed Personal Property Value
	Assessed Land Value
	Assessed Improvement Value
	Total Assessed Value
	Sale Date
	Appraisal Date
	Appraised Personal Property Value
	Appraised Land Value
	Appraised Improvement Value
	Total Appraised Value
	Sale Price
	Zoning
	Deed Book/Page
Buildings	Feature ID
	Dimensions
Streets	Address Ranges
	Street Name

Optional Attribute Requirements

GIS Data Layer	Attributes
Parcels	Owner
	Previous Owner
	Assessment History
	Year Addition
	Year Remodel
	Basement Finish
	Heat Type
	Fireplaces

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	Construction Quality
	Condition of House
	Curb
	Sidewalk
	Utilities (connected/not connected)
	Zoning
	Stories
	Exterior Walls
	Roof
	Basement
	Year Built
	Total number of rooms
	Number of bedrooms
	Number of bathrooms
	Dimensions
	Garage

3. Data Acquisition Options

The parcel boundaries and some attribute information are usually maintained on paper maps. If it has not been completed already, the parcel maps must be digitized into a parcel boundaries GIS data layer. If required, parcel boundaries can also be entered into the GIS using the surveyed dimensions found on the legal deed. This is accomplished using Coordinate Geometry (COGO) that allows the user to enter a bearing and distance for each segment of the property boundary, given a known geographic point. Some localities may keep parcel boundaries in a CAD format. This must be converted into a GIS data layer using standard tools in a GIS program before it can be used in a parcel assessment application.

The attribute data containing information about the property, such as owner and value, is usually housed in a database such as a Computer Aided Mass Appraisal (CAMA). The data in this database can easily be linked to the GIS parcel layer using a common field in both datasets, most often the PIN (Parcel Identification Number) or another unique property ID number.

Planimetric data such as utilities, buildings, land use, streets, etc. are typically maintained at the county or city level, and are often distributed free of charge to local municipalities. Street centerline data layers of varying qualities can be obtained from a number of vendors. The market is relatively competitive, and prices will vary with quality of the data. Relevant vendors that provide this kind of spatial data on a regional and national scale include: NAVTECH <www.navtech.com>, GDT <www.geographic.com>, and TeleAtlas <www.teleatlas.com>.

Other spatial data layers can be obtained through the Internet from various government sources. Municipal boundaries and similar layers can be obtained in digital format through the U.S. Census Bureau <www.census.gov>. Floodplains can be obtained through the FEMA Web site <www.fema.com>.

Regardless of the source of the data, each data layer used to build the property inventory application should be consistent with, or be modified to match, the projection of the Virginia Base Mapping Project (VBMP) orthophotography. This is vital for data consistency across the state and facilitates data sharing across jurisdictional boundaries. The digital orthophotography

provides an excellent base data layer on which to display the property boundaries and associated information.

4. Data Conflation Options (integrated with VBMP digital orthos)

   Data conflation is a process by which two digital data layers, usually of the same area at different points in time, or two different data layers of the same area, are geographically "corrected" through geometrical and rotational transformations so that the different layers can be overlaid on one another. Also called "rubber-sheeting," this process allows a technician to adjust the coordinates of all features on a data layer to provide a more accurate match between known locations and a few data points within the base data set. A good base layer to use for data conflation is the VBMP orthophotos since many features can be seen or interpreted. The need and processes for conflation varies between sets of data, users, and feature types. Any dataset that is updated independently by different departments can be consolidated through conflation. Within most local governments, individual departments are responsible for maintaining specific datasets within their expertise; therefore, conflation is not often necessary. Often, reprojecting the data into a different coordinate system will take care of the misalignment of different data sets. Most industry-standard GIS software has the ability to perform data conflation.

   In the case of property boundaries, it is more efficient to digitize them directly on top of the VBMP orthophotography, if a parcels layer does not already exist. Many property boundary features such as fence lines, driveways, and streams can easily be identified on the orthos. If a parcel data layer already exists, perhaps in CAD format, then it will need to be converted to GIS format and reprojected in order to match the projection of the VBMP orthophotos.

5. GUI / programming options

   There are many options for developers of a GIS-based property inventory application. Three possibilities are:

   - Off-the-shelf GIS desktop application that can be customized to the user's needs
   - Existing commercial applications.
   - Hiring a consultant to develop a custom system from scratch.

   Using a standard GIS software package often requires a significant amount of training and customization. Whereas the initial cost may be lower, the time invested in learning these solutions may generally increase the overall expense of implementation. However, standard GIS software packages deliver more robust data integration, analysis, and cartographic capabilities than do other specialized commercial applications. They have a greater user support infrastructure that allows users to overcome problems quickly. Options for using an existing, industry-standard GIS software application that can be customized for property inventory include those listed in the following table:

   Standard GIS Software Vendors:

Vendor	Software	Web Address
ESRI	ArcView 3.x	http://www.esri.com
ESRI	ArcGIS 8.x	http://www.esri.com
MapInfo	Professional 7.0	http://www.mapinfo.com
Intergraph	GeoMedia 5.0	http://www.intergraph.com/gis

Autodesk	Map 5.0	http://www.autodesk.com

There are an increasing number of vendors developing and implementing parcel management software, including components for inventory functionality. These products may often cost more than standard GIS solutions because of the customization that is required to fit the application into the agency's business practices and/or connect to its data source. The advantage is that a tailored application provides just the functionality that is needed, decreasing the overall application overhead common to industry-standard GIS software. Options for using an existing, commercial parcel management include those listed in the following table:

Commercial Software:

Vendor	Product	Web Address
NovaLIS Technologies	Parcel Editor 8.1	http://www.novalistech.com
RPT, Inc.	GeoPlan – Property Management	http://www.rpt.com/GeoProperty.htm
UCLID	IcoMap	http://www.icomap.com

The final option for developing and implementing a GIS-based property inventory application is to contract a consultant. This option makes certain that a product will fulfill a jurisdiction's requirements. A consultant will be able to develop an application that works with the wide range of hardware and software that are currently in use within local governments within Virginia. Also, training and follow-up user support is often provided at a much more substantial level than with other options.

Ideally, a parcel inventory application would provide the user with the ability to interactively view and search properties and create reports. Another function that should be considered is the integration of scanned plats and deeds with the parcel data layer. Using a common field (such as the ID number of the plat), images can be directly linked to the GIS data layer for quick viewing within the application without having to search through file cabinets of old records.

Another potential time and money saving project might be to set up a specialized GIS application in a public kiosk or computer station that would allow the community to research property information. The main advantage to this type of data access is that it can reduce the amount of work that customer service representatives must undertake each time someone needs a map or information about their property.

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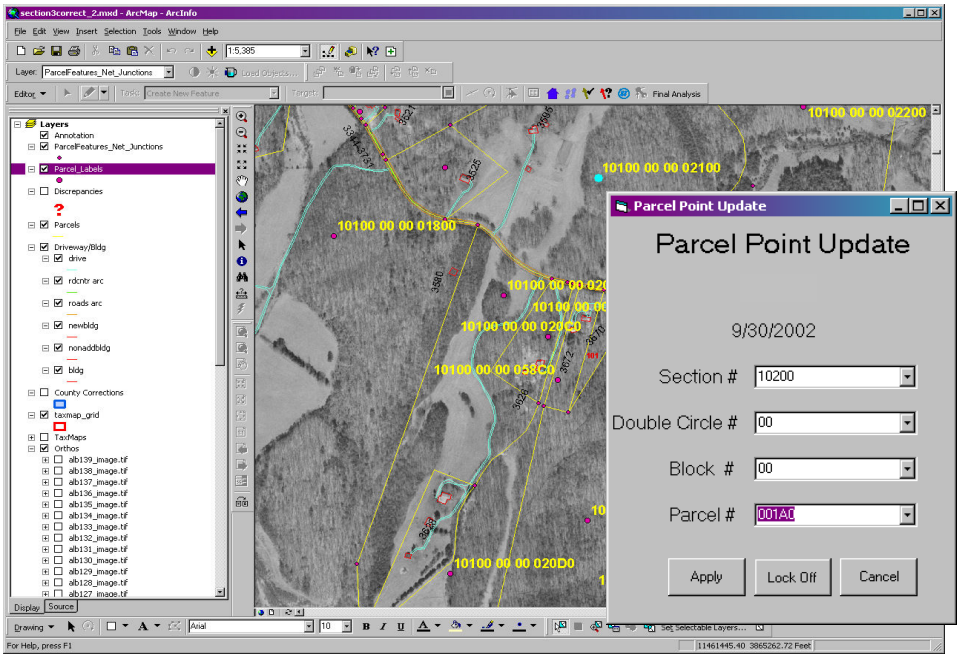

A parcel inventory application that uses an external CAMA database to attribute the parcel data layer.

6. Internet Functionality and options

The Internet has proven itself as a viable solution for local governments to centralize the maintenance and management of services and data. As more local governments are implementing Web-based solutions, they are finding that the Internet requires them to change the nature of an application or its usefulness. Through the flexibility of an Internet solution, software can be easily updated, and users gain greater accessibility to the applications and information they need for their specific tasks through simple, user-friendly interfaces.

Similar to the public kiosk described in Section 5, an application can be deployed on the Web to allow an even greater access to this information for the community. It is also important to point out that Virginia law allows the dissemination of property information via the Web as it is public information. GIS software vendors have products that can be customized in-house or by a consultant to provide Web GIS applications on the Internet, over an intranet or via wireless network. The table below shows GIS vendors and their Internet mapping solutions.

GIS Internet Solutions:

Vendor	Internet Software	Web Address
ESRI	ArcIMS	http://www.esri.com/software/arcims
MapInfo	MapXtreme, MapX	http://www.mapinfo.com
Intergraph	GeoMedia WebMap	http://www.intergraph.com/gis/gmwm
Autodesk	MapGuide	http://www.autodesk.com

7. Technical Requirements

Minimum Technical Requirements
At its most basic level, a GIS-based property inventory application can be used on a single, stand-alone workstation. This workstation would have a hard drive that stores all of the spatial data layers, as well as the GIS software package or application itself. A typical workstation running off-the-shelf software should have the following minimum specifications:

Processor:	Pentium 3; 450 MHz
RAM:	128MB SDRAM at 133MHz
HardDisk:	20GB (min.)
Monitor 1:	19"
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional
Printer:	8x11 office-grade color printer

Optimum Technical Requirements:
A more complex application may require multiple components, including servers, desktop workstations, or handheld devices. For either a desktop or a Web-based application, the system should rely on a fairly robust server computer and high-end workstations. Some examples specifications of the necessary equipment are listed below:

Server

Processor:	Min. 2x Processors, 1.7 GHz, 512K cache
RAM:	Min. 2x 512MB RIMMS
Hard Disk:	Min. 2x 80GB +RAID
Monitor 1:	19"
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
Network Card:	10/100 mbps

Workstation

Processor:	Pentium 4, 1.5 GHz
RAM:	512MB SDRAM at 133MHz
Hard Disk:	20GB (min.)
Monitor 1:	19”
Monitor 2:	17”
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD-RW drive
Modem:	56K
Network Card:	10/100 mbps
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional

Other Components

Printer:	8x11 office-grade color printer and 8x11 production b/w printer
Plotter:	HP DesignJet 1055CM
Tape Backup:	Tape Library Server
UPS:	APC 1400 (or other similar)
Scanner:	11x17
Handheld:	Compaq IPAQ
Network:	T1

8. Administrative/Management Requirements

At the beginning of the project, the assigned project manager from the particular municipality should consider completing some, if not all of the following tasks that relate to the administrative requirements of a property inventory system:

- Determine, with or without the assistance of a consultant hired to develop the system, the preliminary vision and goals of the project.
- Coordinate an initial meeting with the decision-makers (i.e. the Board of Supervisors, City Council, planning department, property assessor, etc.) where the vision and goals of the project are expressed and the background of GIS technology is described, if needed.
- Coordinate with other municipal agencies for data sharing provisions.
- Determine a mechanism of communication to keep the decision-makers aware of the progress of the project.
- Develop a basic understanding of the available precedents in the region/state and research the available technologies that can be applied to the project.

Upon project completion, a basic GIS-based property inventory application will require very little administrative support. Administrative tasks may include loading or upgrading new versions of the software or patches, providing for constant data flow from the source database, and maintaining yearly support contracts on the hardware and software. However, once the system becomes distributed as an enterprise solution to many users throughout a department or deployed on the Internet, there are various other management requirements that need to be fulfilled on a weekly or monthly basis.

At the point where the system grows beyond single desktop users, a devoted administrator or system manager needs to be established. This is essential for the following reasons:

- The system will now be interfacing with other technology systems already in place. Therefore, someone needs to maintain contact with the technology personnel that maintain these systems.
- The manager needs to put into place training schedules to maintain user knowledge of the system.
- Funding will undoubtedly be required to either maintain the system long-term, or continue to expand the system, which requires funding research and applications for grants.

9. Cost – Cost/Benefit

Hardware	**Typical Unit Cost**
Minimum Workstation	$2,000
Optimum Workstation	$3,200
Laptop	$2,400
Web/FTP Server	$8,500
Database Server	$12,000
Data Warehouse Server	$18,000
Backup Server	$5,800
Printer (8x11 color)	$700
Printer (8x11 b/w production)	$2,000
Plotter	$12,000
Tape Library	$5,000

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UPS (Universal Power Supply)	$700
Scanner	$1,500
Handheld	$300-$700

Software (all prices included license)	**Typical Unit Cost**
Off-the-shelf GIS desktop software	$700-$10,000
Customized desktop vendor solution	$5,000-$15,000
Web-based vendor application	$15,000-$25,000
Customized web-based vendor solution	$20,000-$60,000

Miscellaneous	**Typical Unit Cost**
Training – focused vendor training (per person)	$700-$1,000
Training – general GIS	$700-$1,200
Licensing – desktop	$100-$500
Licensing – webapp (1st CPU)	$7,500-$12,000
Maintenance (per year)	$8,000-$15,000

10. Standards / Guidelines Summary
    - Consider creating, customizing, or purchasing an application that integrates parcel inventory functionality with other parcel management issues such as assessments, equalization, or parcel ownership history. This is a more cost-effective solution.
    - A GIS-based parcel inventory application should be built so that non-technical personnel can be trained to use the system.
    - A Web GIS application should be even more simplified for the average citizen to use to research their property information.
    - Acquire input from all departments who will be involved in funding and/or utilizing the application before proceeding with the application design.
    - Create a standardized parcel identification number (PIN) to be used in the application to relate external databases to the GIS parcel data.
    - Determine what information (attributes) about the parcels will be obtained from tax/parcel maps and deeds before digitizing the tax/parcel maps.
    - Develop a detailed Quality Assurance/Quality Control (QA/QC) procedure for reviewing the accuracy of the GIS data and its attributes.
    - Maintain data in the VBMP standard coordinate system (Virginia State Plane, NAD 83, Survey Feet).
    - Create metadata (standard information about GIS data) for each data layer. Metadata tracks the date, origin, coordinate system, and other such information for data layers.

11. Startup Procedures/Steps

    There should be a minimum of eight steps involved with developing a GIS-based property inventory application, after funding is in place to support the project. The steps can be performed in-house or by a consulting team.

    The first task is to complete a detailed Needs Assessment. This process gathers information regarding existing operational procedures, hardware and software, GIS data, and personnel needs. It should include interviews of key individuals throughout the local government agency and other related government departments to obtain a comprehensive view of the agency's operations, and

where GIS might improve them. Basic GIS concepts should be discussed and illustrated to those interviewees that have little prior understanding of GIS. A comprehensive Needs Assessment should then be compiled from the results of the interviews. This document explains the various requirements for a GIS-based property inventory application in the following areas: personnel needs, spatial data development needs, applicable spatial analysis techniques, basic system requirements, including preliminary, general hardware and software recommendations, and training needs.

The second task is to develop a functional requirements document for the proposed system. This document should describe, as completely as possible, all of the technology and functionality that is to be included in the application. This document is used by the local government agency, or its consultant, as the blueprint for the GIS application or system.

- Hardware specifications
- Software purchases
- Detailed descriptions of work-flow, and examples of the graphic user interfaces
- Describe each tool that is part of that graphic user interface, and its functionality
- Describe how data would flow between the different databases and data warehouses, if applicable
- Describe the redundant security measures that will be put in place to make certain of data integrity and confidentiality, when applicable
- Analytical techniques that the application/system provides
- Describe each of the potential products (reports, maps, charts, summary tables) that the user will be able to generate within the system

The third task should be to compile or develop spatial data that can be used by the evolving application. Data can be gathered from a number of online sources, as well as county/city departments. The data layers gathered and maintained should match at least the minimum list provided in Section 1 of this document and can be acquired through the methods described in Section 3 of this document.

On completion and acceptance of the functional requirements document and the development of the spatial and attribute data, the system development and test phase can begin. During this time, the application will be customized as it was outlined in the functional requirements phase. The local government agency should require periodic reviews of the application at particular milestones, such as 50% and 75% completion. This will make certain that problems with the application will be recognized early in the development process, and that the local government agency remains a part of the development process throughout the project timeline.

When the application is nearing 100% completion, it should be installed and tested in the environment in which it will ultimately be used. This allows the users to test the system alongside the application developers, and determine any system integration problems that might arise. It also gives the developers the opportunity to test the application's functionality in a real-world situation. This testing process should be as comprehensive as possible. Each process detailed within the functional requirements should be tested and evaluated at this point.

User training commences once the application reaches 100% completion and is fully documented. Different levels of tutorials and system documentation should be developed depending on the hierarchy of users. Time should be spent at this stage of the project with each potential user of the system to make certain that the proper education occurs. Training should be done through

lessons that use real-life examples of system application. This strategy greatly enhances users' ability to apply the functionality to their jobs.

The next phase of the project should include a document that describes a future plan for wider system development. This document accomplishes two goals. The future plan gives the local government agency ideas on how the system might grow to assist other facets of its business practices. Secondly, it provides the agency with a ready-made grant proposal for applying for potential funding sources.

The final phase of a successful implementation of a GIS-based property inventory application is ongoing technical support. The local government agency should always include this contingency within its cost estimates of a project for a minimum of three months after a system has been put into place. No matter how effective an application appears, problems and system changes inevitably impact the functionality of an application.

12. Estimated time line and/or implementation (stand alone) schedule

Phase	Approximate Duration
RFP/Contract process (construction, posting, proposal acceptance, review, award of contract)	4 months - 1 year
Needs Assessment	2 months
Functional Requirements	1-2 months
Data Development	6-12 months
System Development and Testing	2-4 months
Installation and Testing	1 month
User Training	½ month
Plan for Future Development	½ month
Ongoing Support	3 months

13. Best Practice Examples in Virginia

City of Staunton
Assessor's Office
P.O. Box 58
Staunton, VA 24402
540-332-3827
http://166.67.49.254:8080/staweb/index.asp

County of Hanover
P.O. Box 470
7497 County Complex Rd
Hanover, VA 23069
804-365-6171
http://207.140.67.64/

County of Fairfax
Department of Tax Administration
12000 Government Center Parkway
Fairfax, VA 22035
703-324-4891
http://www.co.fairfax.va.us/dta/re/

City of Richmond
GIS Department
City Hall, Room 1100, MSG-GIS
900 East Broad
Richmond, VA 23219
804-646-7927
http://gisweb.ci.richmond.va.us/isa/

County of Arlington
Department of Real Estate Assessments
2100 Clarendon Blvd, Ste 611
Arlington, VA 22201
703-228-3920
http://www.co.arlington.va.us/REAssessments/Scripts/DreaDefault.asp

County of Loudoun
1 Harrison Street, SE
Leesburg, VA 20175
703-777-0290
http://inter1.co.loudoun.va.us/webpdbs/